

URBAN DIGITAL SURVEY IN GALATA/ BEYOĞLU: REMAINS OF THE GENOESE WALLS AND OF A CARAVANSARY/BAZAR



Fig. 01 - Views from the Caravansaray and drawings with orthophotos from the digital survey.

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A multidisciplinary investigation of Galata's waterfront that combines archival and cartographic research, architectural-historical study, stratigraphic urban analysis, and advanced metric digital surveying. By linking diachronic urban transformations to the physical evidence of surviving walls and structures, the work constructs a coherent narrative supporting conservation, interpretation, and public dissemination – an experience presented and discussed during the International Urban Design Workshop.

Galata, also known as Beyoğlu or Pera, is one of Istanbul's oldest and most stratified districts, it preserves a multilayered historical texture, a key aspect for understanding the urban palimpsest of the Golden Horn. The International Urban Design Workshop "Urban Façade: Istanbul Waterfront" took place

from March 23rd to 30th, 2019, at the Faculty of Architecture and Design, Özyeğin University in Istanbul. The workshop was coordinated by Alessandro Camiz and Giorgio Verdiani in collaboration with the Italian Universities of Parma, Rome "Sapienza", Naples "Federico II", Firenze, Dipartimento di Architettura, Politecnico

di Torino, Dipartimento di Architettura e Design, and Università Mediterranea in Reggio Calabria, the workshop focused on the architectural survey, analysis, and redesign of selected blocks along Galata's waterfront (Dixon, Verdiani, Cornell, 2017). The workshop's concept was not to teach the participants about design transformations

as arbitrary architectural objects but bringing them to see the urban elements as living organisms within the continuous formation of urban tissues (Camiz, Carlotti, Díez, 2017). The studied area represents an important connection between the seafront and the historic sectors in Galata; it acts like Istanbul's "urban façade" towards the Golden Horn (Cuneo, 1987). The workshop addressed issues of contemporary Istanbul, such as the replacement of traditional urban tissues with new

constructions offering globalized one based on evolutionary market and generic features systems, considered coherent (Verdiani et al., 2019). Urban growth demands substitution of building types, this is a certainty in any human settlement in any age, thus, recent interventions have often erased traditional structures, disrupting continuity with the past, and inserting alien typologies or even gross in-style replicas into consolidated contexts (Dallegio D'Alessio, 1946). The teams in the workshop were guided in distinguishing between two modes of transformation:

one based on evolutionary systems, considered coherent with a diachronic urban process, and a disruptive one, aimed at a shifting in the development of creative contrasts with the existing context (Caniggia, Maffei, 1979). The raw data collected during the fieldwork formed the empirical basis of subsequent studies, despite occasional local opposition. The campaign proved successful in documenting the built heritage and fostering further research, including master's theses by Doruk Peker

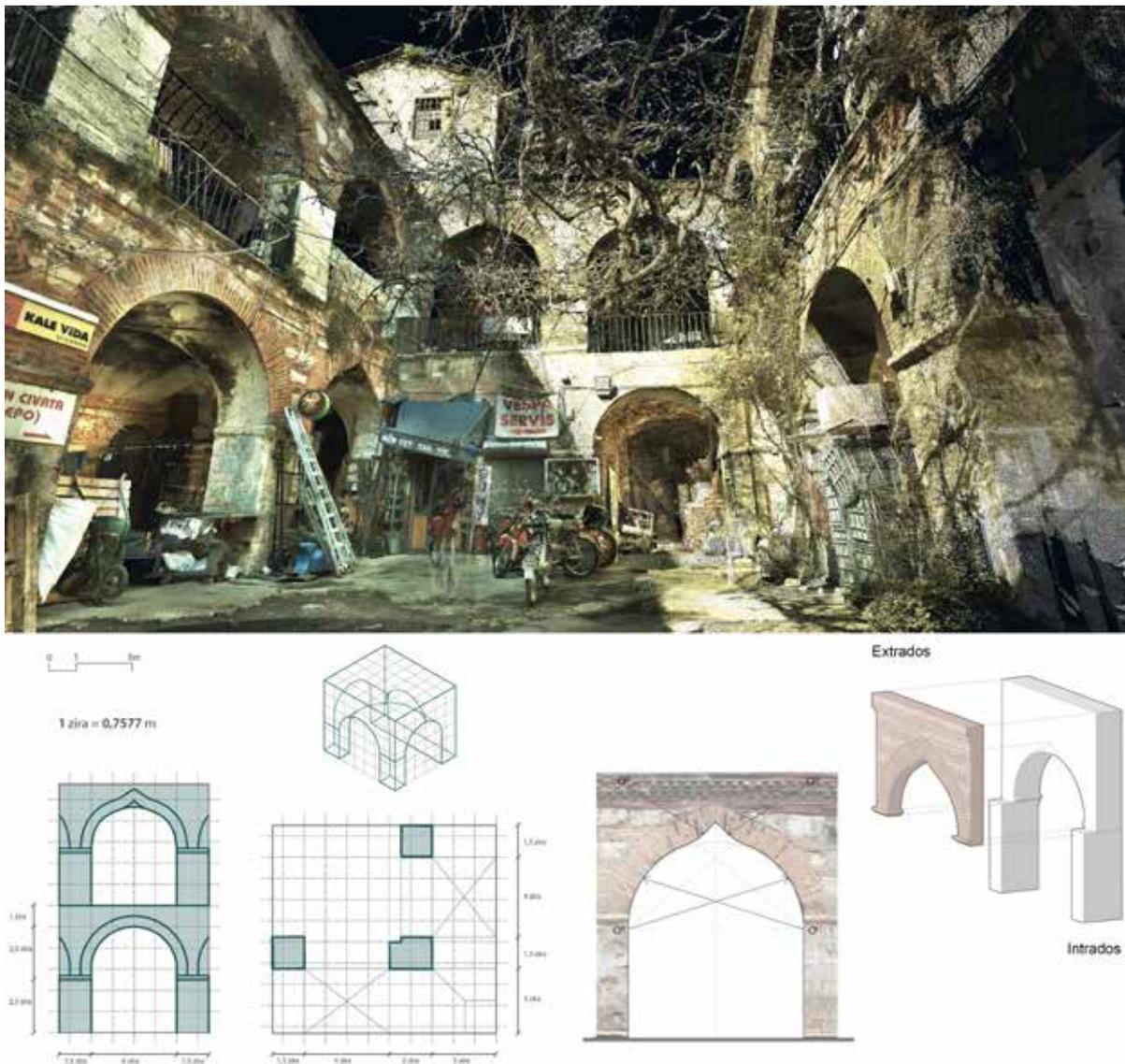


Fig. 02 - View of the point cloud from the Caravansaray and geometrical analysis of its recursive arch (S. Michelon).

(Politecnico di Torino, supervisors R. Spallone, A. Camiz, M. Vitali) and Silvia Michelin (University of Florence, supervisors G. Verdiani, A. Camiz). These works deepened the analysis of Galata's defensive towers, the Beyoğlu urban system, and the Caravansary/Bazaar (Bordini, Cottini, 2019). The interdisciplinary approach combined archival and cartographic research, architectural-historical analysis, stratigraphic reading, and advanced metric surveying, linking diachronic urban transformations to the physical evidence of walls and related structures, ultimately forming a coherent narrative supporting conservation, interpretation, and public dissemination.

URBAN TRANSFORMATIONS OF GALATA/BEYOĞLU

The topographical knowledge of Constantinople and its adjunct settlements is quite fragmentary, and the genesis and morphological evolution of Galata/Beyoğlu (identified in the "Notitia Urbis Constantinopolitana" as Regio tertiadecima) remain only partially reconstructed. While the Ottoman epoch of Galata is documented, earlier chronological stages rely on more limited evidence. Historically significant contributions include Dallegio D'Alessio's 1946 reconstruction, Paolo Cuneo's analyses (1983-1987), and recent studies on the Genoese presence (Sağlam, 2018). Wolfgang Müller's cartographic proposals (1993) emphasize the Genoese walls as mainly Byzantine, a perspective partially echoed by Dewing's (2015) depictions that retain the Galata Tower (erected under Genoese administration

in 1348) as the most identifiable medieval landmark. The diachronic reconstruction hypothesizes successive phases: the initial Megarean colony, the Roman expansions under Constantine and Honorius, and the later Justinian urban reforms. Corroborating evidence derives from sparse documentary sources, archaeological indicators (mostly hydraulic infrastructures) and orientation analysis of current urban patterns. The integration of these data permitted the production of a working topographical model localising primary components of the Roman and Byzantine settlement system in the Galata area, framing the fortifications within a broader urban evolutive trajectory.

DIGITAL SURVEY OPERATIONS

Documenting fragmented and altered fortifications requires meticulous planning to guarantee precision, comprehensiveness, and interoperability of results. The metric campaign adopted a Leica Geosystems ScanStation C10 3D Laser Scanner (time-of-flight), a unit with a declared working range up to 300 meters and point accuracy in the order of a few millimetres at short distances (Bini & Bertocci, 2012; Bianchi et al., 2016). The scanner records a full panoramic sweep, producing point clouds whose density was configured to roughly one point per centimetre at a 10 metres working distance for the majority of scan stations. The device's integrated imaging system captured photographic data for colour-mapping the point cloud without introducing parallax distortions, enabling better reading of the fronts

in their overlays and material identification, rendering masonry, metal fixtures, fissures, voids, and displaced fragments with high visual fidelity. The overall scanning time took three days, covering an area of about 40.000 square metres with 98 scan stations, gathering about one billion of points. For the specific subject of the towers the fieldwork comprised 40 scans: 14 stations concentrated around the first tower (formerly subjected to industrial use), 10 taken from a distance around the second (which was at that time in complete abandon and without any possible direct access), 15 within the sector where recent building additions and a restaurant about the wall was still allowing interesting parts of original masonry work to emerge, and one elevated rooftop scan to enhance inter- sessions alignment. Restricted access and hazardous conditions prevented comprehensive interior scanning; however, exterior apertures and partial interior surveys permitted metric estimations of wall thickness and notable internal features. Data alignment exploited long-range tie features, including the Galata Tower and other distant rooflines, to integrate sectorial point clouds into a coherent global model suited for CAD-based restitution using Autodesk Recap and AutoCAD.

The focal artifact is the second tower located southwest of the Galata Tower: a U-shaped plan of approximately 9.80×7.70 metres and a height near 16 metres. The circular facade confronts a northern courtyard (currently a parking area), while the southern side intersects the city wall

adjacent to the local St. Peter's Church. Observational evidence indicates foundational contact with bedrock, attributable to historical soil lowering that gradually exposed foundational elements. Surface traces, remains of plaster, and imprinting phenomena attest to successive

additions and demolished adjacent structures; presently, a marginal warehouse remains adjacent to the southwestern facade. Successive inappropriate adaptations (fenestration insertions, intermediate floor insertions, non-original claddings) have undermined structural

coherence, generating cracks, projection of beams, and other deterioration signs. The absence of a weatherproof roof accelerates material decay. Given the incomplete internal metric data, interpretative restitution relied on the synthesis of the lasergrammetry taken

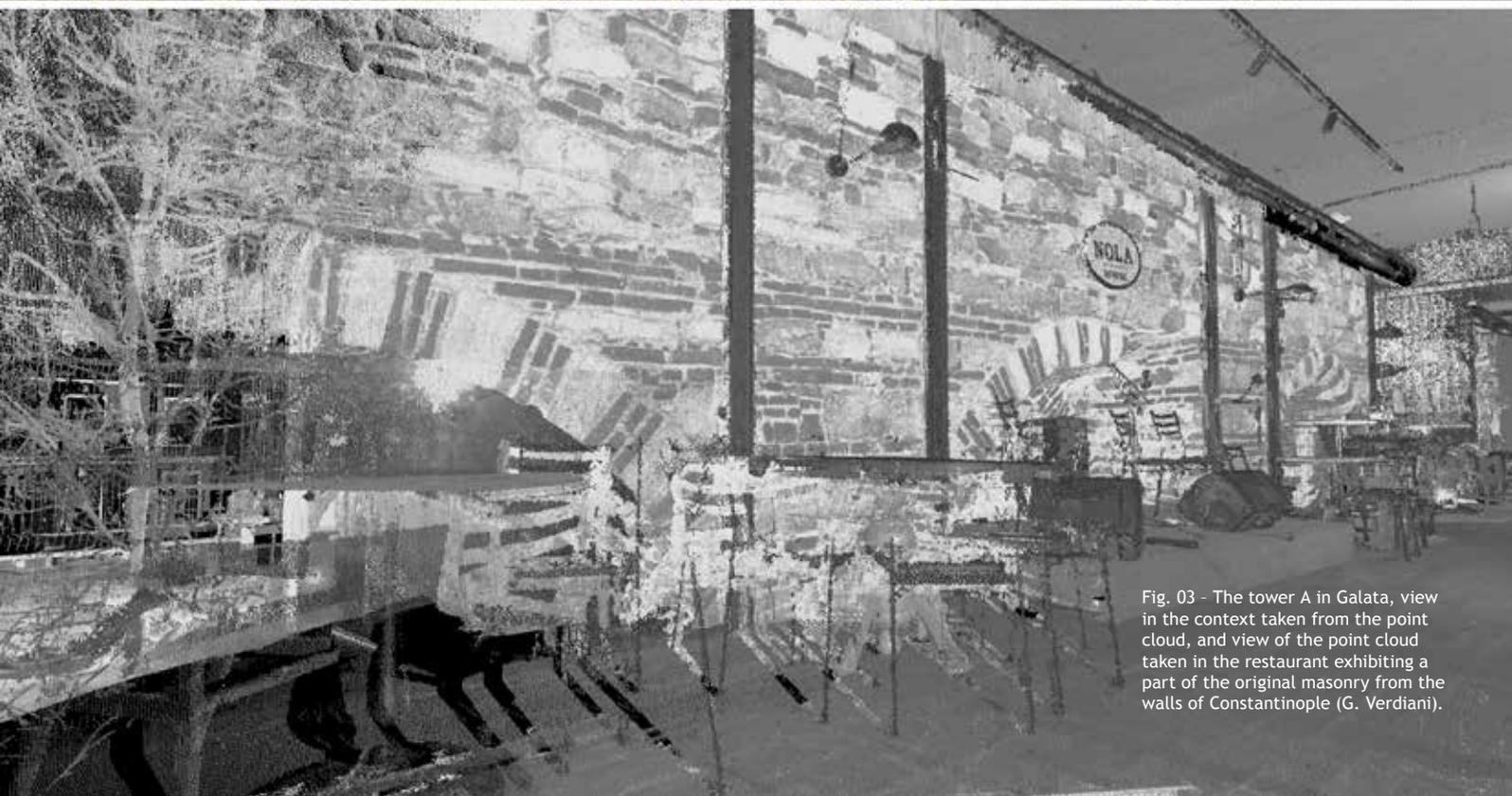


Fig. 03 - The tower A in Galata, view in the context taken from the point cloud, and view of the point cloud taken in the restaurant exhibiting a part of the original masonry from the walls of Constantinople (G. Verdiani).

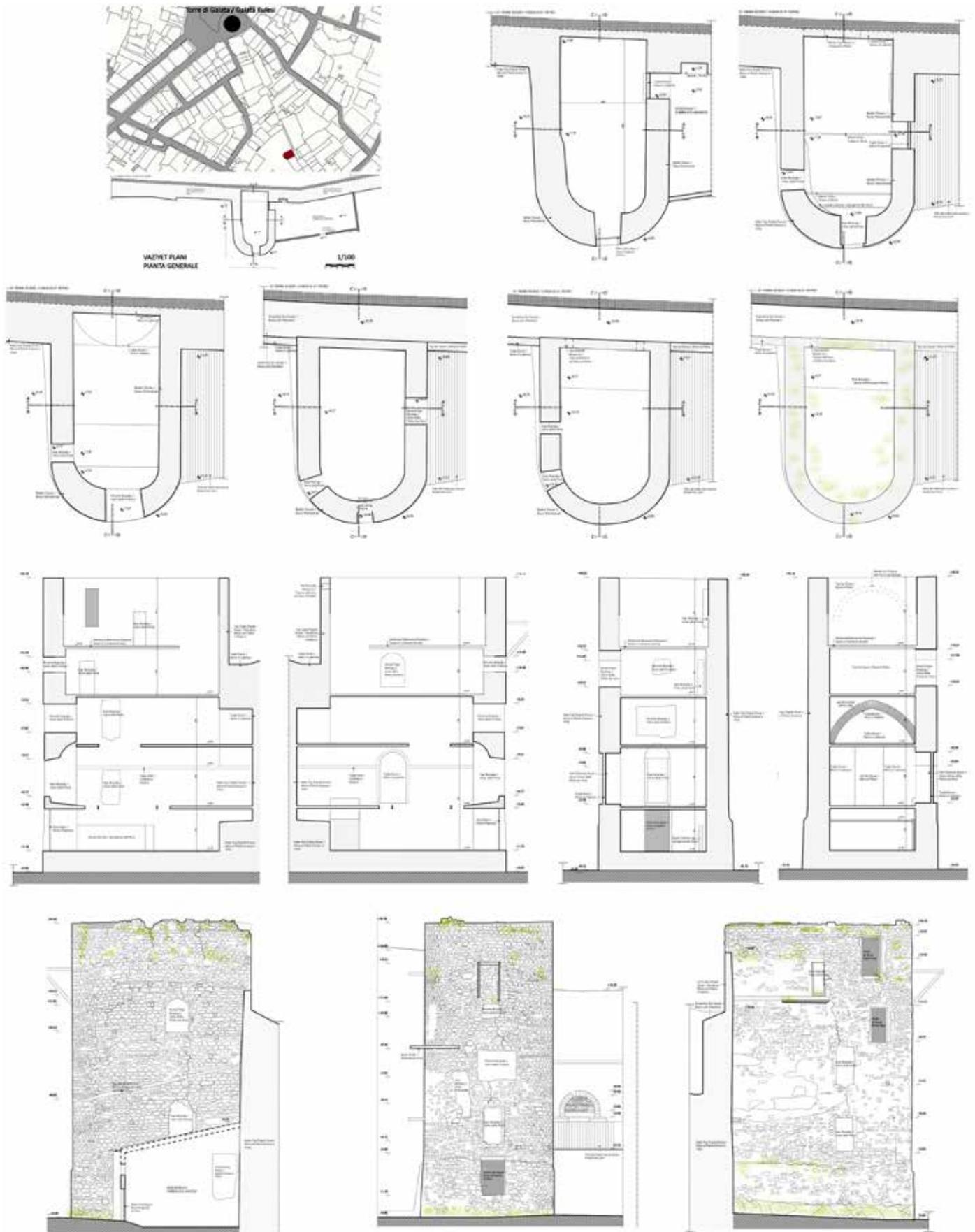


Fig. 04 - Graphic boards with the complete survey of the tower A in Galata/Beyoğlu (D. Peker).

on the external and with few scan stations operated in the interiors. So the profile of the walls was considered as an offset of the external profile getting a better accuracy using the integration of internal traditional measurements, on-site photography, and comparative analogies with better-preserved typologies. In the case of the Caravansary, there is the presence of a classic old market space like those found in Turkey and across the Middle East (Khan Madel, 1988). Currently, this specific one is used by a certain number of hardware shops and technical services. Some exceptions include a painter's studio and a bicycle shop. The robust structure, with thick walls, does a good job in preserving the original layout of the building. Changes to the architectural aspects have been small, mostly involving the adding of features or cutting into the walls for updating the cooling, electrical, and plumbing systems. However, little focus is placed on keeping up the external, internal, and common areas. The documentation of the Caravansaray was done on a partial lasergrammetry integrated and completed by photogrammetry.

The overall result was perfectly functional for analysing and studying the layout and the original features of the building, especially the use of arches and the geometry of the planning grid, allowing a possible attribution to Mimar Sinan himself or to his professional circle (Verdiani and Michelin, 2025). For these built heritage architectures, horizontal and vertical slices of the point cloud produced

accurate profiles used to derive plans, elevations, and sections that were subsequently refined through AutoCAD after Recap pre-processing. This process yielded a comprehensive yet critically annotated graphic dataset that records both measurable geometry and conjectural reconstructions based on archaeological reasoning and stratigraphic reading. Graphic restitution functions as both documentary archive and an operative instrument for conservation planning. The restitution adopted a 1:50 scale which is adequate to represent material texture, door and window frames, and principal forms of degradation: structural fractures, lacunae, material washouts, detachments, and biological colonisation. Selection of horizontal section planes responded to the identification of original and secondary openings (including occluded voids) and to the placement of thin interior slabs surveyed by direct inspection. Plans at varied levels were produced to characterize vertical stratification; vertical sections articulate masonry discontinuities, revealing bonding changes, insertion planes, and back-elevation relations. Elevations derived from orthophotoplanes were supplemented by in-situ eidotypes and direct measurements. The resulting plates synthesise geometric accuracy with thematic mapping of materials, stratifications, and decay patterns, and were designed to be intelligible for conservation professionals, structural engineers, and curators. These drawings emphasize vulnerability

hotspots and inform prioritised conservation interventions, underpinning the proposal for an open-air museum focused on urban memory and accessible interpretation.

CONCLUSIONS

Accurate surveys and systematic documentation of neglected architectural heritage are of real value, enhancing the building condition, enabling multi-user access to metric data, and giving a starting point for restoration, reuse, and virtual reconstruction. Indeed, in the case of total loss, drafts and detailed drawings remain valuable for at least partial virtual restitution and scholarly analysis. Digital documentation enhances the exchange between different professions—from architectural historians to conservation engineers—and opens paths to public engagement, education, and sustainable tourism. The description of masonries, morphological definitions, and stratigraphic interpretations obtained during the Galata case study enable new insights into the different construction phases and provide a basis for targeted interventions. Considering the high risk of loss and progressive alteration of the Galata area, the documentation helps to prevent the indiscriminate conversion of it into an homogeneous sector dominated by transient commercial activities.

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ABSTRACT

Galata, one of the most historically layered districts of Istanbul, represents a critical site for understanding the urban palimpsest of the Golden Horn. The research focuses on the analysis and documentation of selected blocks along the Galata waterfront, investigating the relationship between surviving defensive structures, later architectural additions, and contemporary transformations affecting the district. The study adopts an interdisciplinary methodology combining archival and cartographic research, architectural-historical analysis, stratigraphic urban reading, and advanced metric digital surveying through 3D laser scanning. The resulting point clouds, orthophotos, and CAD restitutions enabled the reconstruction of diachronic transformations and the identification of alterations, discontinuities, and degradation patterns within key architectural artifacts, including the second tower of the fortification system and the historic Caravansary complex.

The integration of empirical survey data and historical sources facilitated the development of a coherent interpretative narrative linking urban growth processes to the physical evidence of masonry structures and spatial organization. This approach contributes to understanding the dynamics through which traditional urban tissues have been replaced by new construction driven by globalized market logic, often compromising typological continuity and authenticity. The outcomes support conservation-oriented strategies, promote informed decision-making for restoration and reuse, and provide a framework for future research and public dissemination. The work, presented and discussed during the International Urban Design Workshop "Urban Façade: Istanbul Waterfront" (2019), highlights the value of accurate documentation as a tool for preserving memory and guiding culturally responsible urban transformation.

KEYWORDS

DIGITAL METRIC SURVEY, 3D LASER SCANNING, POINT CLOUD PROCESSING, STRATIGRAPHIC READING, ARCHIVAL AND CARTOGRAPHIC RESEARCH, ARCHITECTURAL-HISTORICAL ANALYSIS, ORTHOPHOTO AND CAD RESTITUTION, URBAN MORPHOLOGICAL ANALYSIS, DIACHRONIC TRANSFORMATION MAPPING, HERITAGE CONSERVATION STRATEGIES

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